CPC COOPERATIVE PATENT CLASSIFICATION

F04D NON-POSITIVE DISPLACEMENT PUMPS

NOTE

This subclass covers non-positive-displacement pumps for liquids, for elastic fluids, or for liquids and elastic fluids whether rotary or not having pure rotation.

This subclass does not cover combinations of non-positive-displacement pumps with other pumps, which are covered by subclass F04B , except that the use of such other pumps for priming or boosting non-positive-displacement is covered by this subclass.

Attention is drawn to the Notes preceding class F01 , especially as regards the definition of "pump".

Guide heading: **Pumping liquids, or liquids and elastic fluids, by rotary pumps** (pumping liquids and elastic fluids at the same time F04D 31/00)

F04D 1/00 **Radial-flow pumps, e.g. centrifugal pumps**
Helico-centrifugal pumps (adapted for pumping specific fluids F04D 7/00 ; priming or boosting F04D 9/00)

F04D 1/003 . { Having contrarotating parts }

F04D 1/006 . { double suction pumps }

F04D 1/02 . having non-centrifugal stages, e.g. centripetal

F04D 1/025 . . { Comprising axial and raidal stages }

F04D 1/04 . Helico-centrifugal pumps

F04D 1/06 . Multi-stage pumps (F04D 1/02 , F04D 13/10 take precedence)

F04D 1/063 . . { of the vertically split casing type }

F04D 1/066 . . . { the casing consisting of a plurality of annuli bolted together }

F04D 1/08 . . the stages being situated concentrically

F04D 1/10 . . with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side loads

F04D 1/12 . Pumps with scoops or like paring members protruding in the fluid circulating in a bowl

F04D 1/14 . Pumps raising fluids by centrifugal force within a conical rotary bowl with vertical axis

F04D 3/00 **Axial-flow pumps** (priming or boosting F04D 9/00)

F04D 3/005 . { with a conventional single stage rotor }

F04D 3/02 . of screw type

F04D 5/00 **Pumps with circumferential or transverse flow** { (control thereof F04D 15/005) }

F04D 5/001 . { Shear force pumps }

F04D 5/002 . { Regenerative pumps (for elastic fluids F04D 23/008) }
F04D 5/003 . . { of multistage type }
F04D 5/005 . . . { the stages being radially offset }
F04D 5/006 . . . { the stages being axially offset }
F04D 5/007 . . { Details of the inlet or outlet }
F04D 5/008 . . { Details of the stator, e.g. channel shape }

F04D 7/00 **Pumps adapted for handling specific fluids, e.g. by selection of specific materials for pumps or pump parts** (F04D 11/005 , F04D 29/22 take precedence)

F04D 7/02 . of centrifugal type
F04D 7/04 . . the fluids being viscous or non-homogenous
F04D 7/045 . . . { with means for comminuting, mixing stirring or otherwise treating }
F04D 7/06 . . the fluids being hot or corrosive, e.g. liquid metals
F04D 7/065 . . . { for liquid metal }
F04D 7/08 . . the fluids being radioactive

F04D 9/00 **Priming**
Preventing vapour lock

F04D 9/001 . { Preventing vapour lock (F04D 9/041 takes precedence) }
F04D 9/002 . . { by means in the very pump (F04D 9/041 takes precedence) }
F04D 9/003 . . . { separating and removing the vapour }

F04D 9/004 . { Priming of not self-priming pumps }
F04D 9/005 . . { by adducting or recycling liquid (F04D 9/006 takes precedence) }
F04D 9/006 . . { by venting gas or using gas valves }

F04D 9/007 . { Preventing loss of prime, siphon breakers (stopping of pumps F04D 15/02) }
F04D 9/008 . . { by means in the suction mouth, e.g. foot valves }

F04D 9/02 . Self-priming pumps

F04D 9/04 . Using priming pumps
Using booster pumps to prevent vapour-lock
F04D 9/041 . . { the priming pump having evacuating action (F04D 9/043 and F04D 9/06 take precedence) }
F04D 9/042 . . . { and means for rendering its in operative }
F04D 9/043 . . { the priming pump being hand operated or of the reciprocating type }

F04D 9/044 . . { Means for rendering the priming pump inoperative }
F04D 9/045 . . . { the means being liquid level sensors }
F04D 9/046 . . . . { the means being floats }
F04D 9/047 . . . { the means being flow sensors }
F04D 9/048 . . . { the means being outlet pressure sensors }
F04D 9/049 . . . { by operator interventions }
F04D 9/06 . . of jet type
F04D 9/065 . . . { the driving fluid being a gas or vapour, e.g. exhaust of a combustion engine }

F04D 11/00 **Other rotary non-positive-displacement pumps** (pumping installations or systems F04D 13/00)

F04D 11/005 . { Swash-type impeller pumps }

F04D 13/00 **Pumping installations or systems** (controlling F04D 15/00)

F04D 13/02 . Units comprising pumps and their driving means (predominant aspects of the driving means, see the relevant classes for such means)
F04D 13/021 . . { containing a coupling }
F04D 13/022 . . . { a coupling allowing slip, e.g. torque converter }
F04D 13/023 . . . . { for reducing start torque }
F04D 13/024 . . . { a magnetic coupling }
F04D 13/025 . . . . { Details of the can separating the pump and drive area }
F04D 13/026 . . . . { Details of the bearings }
F04D 13/027 . . . . { Details of the magnetic circuit }
F04D 13/028 . . { the driving means being a planetary gear }
F04D 13/04 . . the pump being fluid driven
F04D 13/043 . . . { the pump wheel carrying the fluid driving means }
F04D 13/046 . . . { the fluid driving means being a hydraulic motor of the positive displacement type }
F04D 13/06 . . the pump being electrically driven
F04D 13/0606 . . . { Canned motor pumps }
F04D 13/0613 . . . . { Special connection between the rotor compartments }
F04D 13/062 . . . . { pressure compensation between motor- and pump- compartment }
F04D 13/0626 . . . . { Details of the can }
F04D 13/0633 . . . . { Details of the bearings }
F04D 13/064 . . . . { Details of the magnetic circuit }
F04D 13/0646 . . . { the hollow pump or motor shaft being the conduit for the working fluid }
F04D 13/0653 . . . { the motor being flooded }
F04D 13/066 . . . { Floating-units }
F04D 13/0666 . . . { the motor being of the plane gap type }
F04D 13/0673 . . . { the motor being of the inside-out type }
F04D 13/068 . . . { Battery powered }

F04D 13/0686 . . . { Mechanical details of the pump control unit (pump control F04D 15/00) }
F04D 13/0693 . . . { Details or arrangements of the wiring }
F04D 13/08 . . . for submerged use
F04D 13/083 . . . . { and protected by a gas-bell }
F04D 13/086 . . . . { the pump and drive motor are both submerged }
F04D 13/10 . . . . adapted for use in mining bore holes

F04D 13/12 . Combinations of two or more pumps (combinations with priming pumps or booster pumps to counteract vapour-lock F04D 9/04)
F04D 13/14 . . the pumps being all of centrifugal type { (deviation valves F04D 15/0016) }

F04D 13/16 . with storage reservoirs

F04D 15/00 Control, e.g. regulation, of pumps, pumping installations or systems

F04D 15/0005 . { by using valves }
F04D 15/0011 . . { by-pass valves }
F04D 15/0016 . . { mixing-reversing- or deviation valves }
F04D 15/0022 . . { throttling valves or valves varying the pump inlet opening or the outlet opening }

F04D 15/0027 . { Varying behaviour or the very pump (F04D 15/0055 and F04D 29/46 take precedence) }
F04D 15/0033 . . { By-passing by increasing clearance between impeller and its casing }
F04D 15/0038 . . { by varying the effective cross-sectional area of flow through the rotor }
F04D 15/0044 . . { by introducing a gas }
F04D 15/005 . . { the pumps being of the circumferential flow type }

F04D 15/0055 . { Rotors with adjustable blades }
F04D 15/0061 . . { responsive to temperature }

F04D 15/0066 . { by changing the speed, e.g. of the driving engine }

F04D 15/0072 . { Installation or systems with two or more pumps, wherein the flow path through the stages can be changed, e.g. series-parallel }

F04D 15/0077 . { Safety measures (F04D 15/02 takes precedence) }
F04D 15/0083 . . { Protection against sudden pressure change, e.g. check valves }

F04D 15/0088 . { Testing machines }

F04D 15/0094 . { Indicators of rotational movement }

F04D 15/02 . Stopping of pumps, or operating valves, on occurrence of unwanted conditions
F04D 15/0209 . . { responsive to a condition of the working fluid (F04D 15/029 takes precedence) }
F04D 15/0218 . . . { the condition being a liquid level or a lack of liquid supply }
F04D 15/0227 . . . . { Lack of liquid level being detected using a flow transducer }

F04D 15/0236 . . . . { Lack of liquid level being detected by analysing the parameters of the electric drive, e.g. current or power consumption }

F04D 15/0245 . . { responsive to a condition of the pump }

F04D 15/0254 . . . { the condition being speed or load }

F04D 15/0263 . . . { the condition being temperature, ingress of humidity or leakage }

F04D 15/0272 . . . { the condition being wear or a position }

F04D 15/0281 . . { responsive to a condition not otherwise provided for }

F04D 15/029 . . { for pumps operating in parallel }

Guide heading: **Pumping elastic fluids by rotary pumps**

F04D 17/00 **Radial-flow pumps e.g. centrifugal pumps**
Helico-centrifugal pumps (F04D 21/00 takes precedence)

F04D 17/02 . having non-centrifugal stages, e.g. centripetal

F04D 17/025 . . { comprising axial flow and radial flow stages }

F04D 17/04 . . of transverse-flow type

F04D 17/06 . Helico-centrifugal pumps

F04D 17/08 . Centrifugal pumps

F04D 17/10 . . for compressing or evacuating

F04D 17/105 . . . { with double suction }

F04D 17/12 . . . Multi-stage pumps

F04D 17/122 . . . . { the individual rotor discs being, one for each stage, on a common shaft and axially spaced, e.g. conventional centrifugal multi- stage compressors }

F04D 17/125 . . . . . { the casing being vertically split }

F04D 17/127 . . . . { with radially spaced stages, e.g. for contrarotating type }

F04D 17/14 . . . . with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side-loads, (surge control F04D 27/02)

F04D 17/16 . . for displacing without appreciable compression

F04D 17/161 . . . { Shear force pumps }

F04D 17/162 . . . { Double suction pumps }

F04D 17/164 . . . { Multi-stage fans, e.g. for vacuum cleaners }

F04D 17/165 . . . { Axial entry and discharge }

F04D 17/167 . . . { Operating by means of fibrous or porous elements (suction filters F04D 29/701) ; e.g. with sponge rotors }

F04D 17/168 . . . { Pumps specially adapted to produce a vacuum }

F04D 17/18 . . characterised by use of centrifugal force of liquids entrained in pumps { e.g. by means of an auxiliary liquid; fluid ring compressors F04C 19/00 }

F04D 19/00 **Axial-flow pumps** (F04D 21/00 takes precedence) **;** { pump comprising axial flow and radial flow stages F04D 17/025 }

F04D 19/002 . { Axial flow fans }

F04D 19/005 . . { reversible fans }

F04D 19/007 . { multistage fans }

F04D 19/02 . Multi-stage pumps

F04D 19/022 . . { with concentric rows of vanes; }

F04D 19/024 . . { with contrarotating parts }

F04D 19/026 . . { with a plurality of shafts rotating at different speeds (F04D 19/022 takes precedence) }

F04D 19/028 . . { Layout of fluid flow through the stages }

F04D 19/04 . . specially adapted to the production of a high vacuum, e.g. molecular pumps

F04D 19/042 . . . { Turbomolecular vacuum pumps }

F04D 19/044 . . . { Holweck-type pumps }

F04D 19/046 . . . { Combinations of two or more different types of pumps }

F04D 19/048 . . . { comprising magnetic bearings }

F04D 21/00 **Pump involving supersonic speed of pumped fluids**

F04D 23/00 **Other rotary non-positive-displacement pumps** (pumping installations or systems F04D 25/00)

F04D 23/001 . { Pumps adapted for conveying materials or for handling specific elastic fluids }

F04D 23/003 . . { of radial-flow type }

F04D 23/005 . . { of axial-flow type }

F04D 23/006 . { Creating a pulsating flow }

F04D 23/008 . { Regenerative pumps (for liquids or for liquids and elastic fluids 5/00R) }

F04D 25/00 **Pumping installations or systems** (controlling F04D 27/00)

F04D 25/02 . Units comprising pumps and their driving means (predominant aspect of the driving means, see the relevant classes for such means)

F04D 25/022 . . { comprising a yielding coupling, e.g. hydraulic (a magnetic coupling 25/02D) }

F04D 25/024 . . { the driving means being assisted by a power recovery turbine }

F04D 25/026 . . { with a magnetic coupling }

F04D 25/028 . . { the driving means being a planetary gear }

F04D 25/04 . . the pump being fluid-driven { (pumps driven by exhaust gases F02B 37/00 , F02B 39/00 ; turbochargers F02C 6/12) }

F04D 25/045 . . . { the pump wheel carrying the fluid driving means, e.g. turbine blades }

F04D 25/06 . . the pump being electrically driven (F04D 25/08 takes precedence)

F04D 25/0606 . . . { the electric motor being specially adapted for integration in the pump }

F04D 25/0613 . . . . { the electric motor being of the inside-out type, i.e. the rotor is arranged radially outside a central stator }

F04D 25/062 . . . . . { Details of the bearings }

F04D 25/0626 . . . . . { Details of the lubrication }
F04D 25/0633 . . . . . { Details of the magnetic circuit }
F04D 25/064 . . . . . { Details of the rotor }
F04D 25/0646 . . . . . { Details of the stator }
F04D 25/0653 . . . . { the motor having a plane air gap, e.g. disc-type }
F04D 25/066 . . . . { Linear Motors }
F04D 25/0666 . . . . { a sensor is integrated into the pump/motor design }
F04D 25/0673 . . . { Battery powered }
F04D 25/068 . . . { Mechanical details of the pump control unit (pump control details F04D27) }
F04D 25/0686 . . . { specially adapted for submerged use }
F04D 25/0693 . . . { Details or arrangements of the wiring }
F04D 25/08 . . the working fluid being air, e.g. for ventilation
F04D 25/082 . . . { the unit having provision for cooling the motor }
F04D 25/084 . . . { hand fans }
F04D 25/086 . . . . { hand operated }
F04D 25/088 . . . { Ceiling fans }
F04D 25/10 . . . the unit having provisions for automatically changing direction of output air
F04D 25/105 . . . . { by changing rotor axis direction, e.g. oscillating fans (interconnecting rotary motion and oscillating motion F16H) }
F04D 25/12 . . . the unit being adapted for mounting in apertures
F04D 25/14 . . . . and having shutters, e.g. automatically closed when not in use

F04D 25/16 . Combinations of two or more pumps { Producing two or more separate gas flows }
F04D 25/163 . . { driven by a common gearing arrangement }
F04D 25/166 . . { using fans }

F04D 27/00 **Control, e.g. regulation, of pumps, pumping installations or systems**

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 which covers also control in general not focussing on surge control

F04D 27/001 . { Testing thereof; Determination or simulation of flow characteristics; Stall or surge detection, e.g. condition monitoring }

F04D 27/002 . { by varying geometry within the pumps, e.g. by adjusting vanes }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 C

F04D 27/003 . { by throttling (F04D 27/002 takes precedence) }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 D)

F04D 27/004 . { by varying driving speed }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 F

F04D 27/005 . { by changing flow path between different stages or between a plurality of compressors; Load distribution between compressors }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 G]

F04D 27/006 . { by influencing fluid temperatures }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 K

F04D 27/007 . { Conjoint control of two or more different functions }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 L

F04D 27/008 . { Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/0292

F04D 27/009 . { by bleeding, by passing or recycling fluid }

WARNING

This group is not complete pending a reorganisation. See also group F04D 27/02 B

F04D 27/02 . Surge control { (surge detection F04D 27/001) }
F04D 27/0207 . . { by bleeding, bypassing or recycling fluids } (influencing the boundary layer by an uncontrolled bleeding of the working fluid F04D 29/681)
F04D 27/0215 . . . { Arrangements therefor, e.g. bleed or by-pass valves }
F04D 27/0223 . . . { Control schemes therefor }
F04D 27/023 . . . { Details or means for fluid extraction }
F04D 27/0238 . . . { Details or means for fluid reinjection }
F04D 27/0246 . . { by varying geometry within the pumps, e.g. by adjusting vanes }
F04D 27/0253 . . { by throttling (F04D 27/0246 takes precedence) }
F04D 27/0261 . . { by varying driving speed }
F04D 27/0269 . . { by changing flow path between different stages or between a plurality of compressors; load distribution between compressors }
F04D 27/0276 . . { by influencing fluid temperature }
F04D 27/0284 . . { Conjoint control of two or more different functions }
F04D 27/0292 . . { Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves }

F04D 29/00 **Details, component parts, or accessories** (machine elements in general F16)

F04D 29/002 . { especially adapted for elastic fluid pumps }

F04D 29/005 . { Decorative aspects, i.e. features which have no effect on the functioning of the pump }

F04D 29/007 . { especially adapted for liquid pumps }

F04D 29/02 . Selection of particular materials (for handling specific liquids F04D 7/00 { F04D 23/001 })
F04D 29/023 . . { especially adapted for elastic fluid pumps }
F04D 29/026 . . { especially adapted for liquid pumps }

F04D 29/04 . Shafts or bearings, or assemblies thereof (specially adapted for elastic fluid pumps F04D 29/05)
F04D 29/0405 . . { joining shafts, e.g. rigid couplings, quill shafts } { WARNING: The group F04D 29/0405 is no longer used for the classification of new documents as from July 1st, 2007. The backlog of this group is being continuously reclassified to F04D 29/044 and F04D 29/054 }
F04D 29/041 . . Axial thrust balancing
F04D 29/0413 . . . { hydrostatic; hydrodynamic thrust bearings }
F04D 29/0416 . . . { balancing pistons }
F04D 29/042 . . Axially shiftable rotors F04D 29/041 takes precedence { control by creating a by-pass F04D 15/0027 }
F04D 29/043 . . Shafts
F04D 29/044 . . . Arrangements for joining or assembling shafts
F04D 29/046 . . Bearings
F04D 29/0462 . . . { Bearing cartridges }

F04D 29/0465 . . . { Ceramic bearing designs }

F04D 29/0467 . . . { Spherical bearings }

F04D 29/047 . . . hydrostatic
hydrodynamic

F04D 29/0473 . . . . { for radial pumps }

F04D 29/0476 . . . . { for axial pumps }

F04D 29/048 . . . magnetic
electromagnetic

F04D 29/049 . . . Roller bearings

F04D 29/05 . Shafts or bearings, or assemblies thereof, specially adapted for elastic fluid pumps

F04D 29/051 . . Axial thrust balancing

F04D 29/0513 . . . { hydrostatic; hydrodynamic thrust bearings }

F04D 29/0516 . . . { balancing pistons }

F04D 29/052 . . Axially shiftable rotors F04D 29/051 takes precedence { control by creating a by-pass F04D 27/0246 }

F04D 29/053 . . Shafts

F04D 29/054 . . . Arrangements for joining or assembling shafts

F04D 29/056 . . Bearings

F04D 29/0563 . . . { Bearings cartridges }

F04D 29/0566 . . . { Ceramic bearing designs }

F04D 29/057 . . . hydrostatic
hydrodynamic

F04D 29/058 . . . magnetic
electromagnetic

F04D 29/059 . . . Roller bearings

F04D 29/06 . Lubrication { (F04D 13/0606 , F04D 13/0646 , F04D 13/0653 take precedence) }

F04D 29/061 . . { especially adapted for liquid pumps }

F04D 29/063 . . especially adapted for elastic fluid pumps

F04D 29/08 . Sealings

F04D 29/083 . . { especially adapted for elastic fluid pumps }

F04D 29/086 . . { especially adapted for liquid pumps }

F04D 29/10 . . Shaft sealings

F04D 29/102 . . . { especially adapted for elastic fluid pumps }

F04D 29/104 . . . . { the sealing fluid being other than the working fluid or being the working fluid treated }

F04D 29/106 . . . { especially adapted for liquid pumps }

F04D 29/108 . . . . { the sealing fluid being other than the working liquid or being the working liquid treated }

F04D 29/12 . . . using sealing-rings

F04D 29/122 . . . . { especially adapted for elastic fluid pumps }

F04D 29/124 . . . . . { with special means for adducting cooling or sealing fluid }

F04D 29/126 . . . . { especially adapted for liquid pumps }

F04D 29/128 . . . . . { with special means for adducting cooling or sealing fluid }
F04D 29/14 . . . operative only when pump is inoperative
F04D 29/143 . . . . { especially adapted for elastic fluid pumps }
F04D 29/146 . . . . { especially adapted for liquid pumps }
F04D 29/16 . . between pressure and suction sides
F04D 29/161 . . . { especially adapted for elastic fluid pumps }
F04D 29/162 . . . . { of a centrifugal flow wheel }
F04D 29/164 . . . . { of an axial flow wheel }
F04D 29/165 . . . { especially adapted for liquid pumps }
F04D 29/167 . . . . { of a centrifugal flow wheel }
F04D 29/168 . . . . { of an axial flow wheel }

F04D 29/18 . Rotors (specially for elastic fluids F04D 29/26)
F04D 29/181 . . { Axial flow rotors (F04D 29/185 take precedence) }
F04D 29/183 . . . { Semi axial flow rotors }
F04D 29/185 . . { Rotors consisting of a plurality of wheels }
F04D 29/186 . . { Shaftless rotors (F04D 13/024 takes precedence) }
F04D 29/188 . . { specially for regenerative pumps }
F04D 29/20 . . Mounting rotors on shafts
F04D 29/22 . . specially for centrifugal pumps
F04D 29/2205 . . . { Conventional flow pattern (F04D 29/18 takes precedence) }
F04D 29/2211 . . . . { More than one set of flow passages }
F04D 29/2216 . . . . { Shape, geometry (F04D 29/2211 takes precedence) }
F04D 29/2222 . . . . { Construction and assembly (F04D 29/2211 takes precedence) }
F04D 29/2227 . . . . . { for special materials }
F04D 29/2233 . . . . . { entirely open or stamped from one sheet }
F04D 29/2238 . . . { Special flow patterns (F04D 11/005 takes precedence) }
F04D 29/2244 . . . . { Free vortex }
F04D 29/225 . . . . { Channel wheels, e.g. one blade or one flow channel }
F04D 29/2255 . . . . { flow-channels with a special cross-section contour, e.g. ejecting, throttling or diffusing effect }
F04D 29/2261 . . . { with special measures }
F04D 29/2266 . . . . { for sealing or thrust balance (F04D 29/04 and F04D 29/16 take precedence) }
F04D 29/2272 . . . . { for influencing flow or boundary layer }
F04D 29/2277 . . . . { for increasing NPSH or dealing with liquids near boiling-point }
F04D 29/2283 . . . . { for reverse pumping action }
F04D 29/2288 . . . . { for comminuting, mixing or separating }
F04D 29/2294 . . . . { for protection, e.g. against abrasion }
F04D 29/24 . . . Vanes
F04D 29/242 . . . . { Geometry, shape }
F04D 29/245 . . . . . { for special effects }

F04D 29/247 . . . . { elastic or self-adjusting }

F04D 29/26 . Rotors specially for elastic fluids
F04D 29/263 . . { mounting fan or blower rotors on shafts }
F04D 29/266 . . { mounting compressor rotors on shafts }
F04D 29/28 . . for centrifugal or helico-centrifugal pumps { for radial-flow or helico-centrifugal pumps }
F04D 29/281 . . . { for fans or blowers }
F04D 29/282 . . . . { the leading edge of each vane being substantially parallel to the rotation axis }
F04D 29/283 . . . . . { rotors of the squirrel-cage type }
F04D 29/284 . . . { for compressors }
F04D 29/285 . . . . { the compressor wheel comprising a pair of rotatable bladed hub portions axially aligned and clamped together }
F04D 29/286 . . . . { multi-stage rotors }
F04D 29/287 . . . { with adjusting means }
F04D 29/288 . . . { Part of the wheel having an ejecting effect e.g. being bladeless diffuser }
F04D 29/289 . . . { having provision against erosion or for dust-separation }
F04D 29/30 . . . Vanes
F04D 29/305 . . . . { Flexible vanes }
F04D 29/32 . . for axial flow pumps { multistage rotors F01D 5/00 }
F04D 29/321 . . . { for axial flow compressors }
F04D 29/322 . . . . { blade mountings (F01D 5/30 takes precedence) }
F04D 29/323 . . . . . { adjustable }
F04D 29/324 . . . . { blades (F01D 5/282 takes precedence) }
F04D 29/325 . . . { for axial flow fans (blade mountings F04D 29/34 , blades F04D 29/38) }
F04D 29/326 . . . . { comprising a rotating shroud }
F04D 29/327 . . . . { with non identical blades }
F04D 29/328 . . . . { with unequal distribution of blades around the hub }
F04D 29/329 . . . . { Details of the hub }
F04D 29/34 . . . Blade mountings { for axial flow compressors F04D 29/322 }
F04D 29/36 . . . . adjustable { flexible blades F04D 29/382 }
F04D 29/362 . . . . . { during rotation }
F04D 29/364 . . . . . { The blades having only a predetermined number of possible positions }
F04D 29/366 . . . . . { Adjustment by interaction of inertion and lift }
F04D 29/368 . . . . . { Adjustment by differences of temperature }
F04D 29/38 . . . Blades { (for axial flow compressors F04D 29/324) }
F04D 29/382 . . . . { Flexible blades }
F04D 29/384 . . . . { characterised by form }
F04D 29/386 . . . . . { Skewed blades }
F04D 29/388 . . . . { characterised by construction }

F04D 29/40 . Casings

Connections of working fluid { bleed or by-pass valves F04D 15/0011 , F04D 27/0215 }

F04D 29/403 .. { especially adapted for elastic fluid pumps }

F04D 29/406 .. { especially adapted for liquid pumps }

F04D 29/42 .. for radial or helico-centrifugal pumps

F04D 29/4206 ... { especially adapted for elastic fluid pumps }

F04D 29/4213 .... { suction ports }

F04D 29/422 .... { Discharge tongues (F04D 17/04 takes precedence) }

F04D 29/4226 .... { Fan casings }

F04D 29/4233 ..... { with volutes extending mainly in axial or radially inward direction }

F04D 29/424 ..... { Double entry casings }

F04D 29/4246 ..... { comprising more than one outlet }

F04D 29/4253 ..... { with axial entry and discharge }

F04D 29/426 ... { especially adapted for liquid pumps }

F04D 29/4266 .... { made of sheet metal }

F04D 29/4273 .... { suction eyes }

F04D 29/428 .... { Discharge tongues (F04D 17/04 takes precedence) }

F04D 29/4286 .... { inside lining e.g. rubber }

F04D 29/4293 .... { Details of fluid inlet or outlet }

F04D 29/44 ... Fluid-guiding means, e.g. diffusers

F04D 29/441 .... { especially adapted for elastic fluid pumps }

F04D 29/442 ..... { rotating diffusers }

F04D 29/444 ..... { Bladed diffusers }

F04D 29/445 .... { especially adapted for liquid pumps }

F04D 29/447 ..... { rotating diffusers }

F04D 29/448 ..... { bladed diffusers }

F04D 29/46 .... adjustable

F04D 29/462 ..... { especially adapted for elastic fluid pumps }

F04D 29/464 ..... { adjusting flow cross-section, otherwise than by using adjustable stator blades }

F04D 29/466 ..... { especially adapted for liquid fluid pumps }

F04D 29/468 ..... { adjusting flow cross-section, otherwise than by using adjustable stator blades }

F04D 29/48 ..... for unidirectional fluid flow in reversible pumps { rotors for reverse action F04D 29/2283 }

F04D 29/483 ..... { especially adapted for elastic fluid pumps }

F04D 29/486 ..... { especially adapted for liquid pumps }

F04D 29/50 ..... for reversing fluid flow { rotors for reverse action F04D 29/2283 }

F04D 29/503 ..... { especially adapted for elastic fluid pumps }

F04D 29/506 ..... { especially adapted for liquid pumps }

F04D 29/52 .. for axial pumps

F04D 29/522 ... { especially adapted for elastic fluid pumps }

F04D 29/524 .... { shiftable members for obturating part of the flow path }

F04D 29/526 .... { Details of the casing section radially opposing blade tips (ducts F04D 29/545) }

F04D 29/528 ... { especially adapted for liquid pumps }

F04D 29/54 ... Fluid-guiding means, e.g. diffusers

F04D 29/541 .... { Specially adapted for elastic fluid pumps (F04D 29/56 takes precedence) }

F04D 29/542 ..... { Bladed diffusers (fixing blades to stators F01D 9/042) }

F04D 29/544 ..... { Blade shapes }

F04D 29/545 ..... { Ducts }

F04D 29/547 ..... { having a special shape in order to influence fluid flow }

F04D 29/548 .... { Specially adapted for liquid pumps (F04D 29/56 takes precedence) }

F04D 29/56 .... adjustable

F04D 29/563 ..... { specially adapted for elastic fluid pumps }

F04D 29/566 ..... { specially adapted for liquid pumps }

F04D 29/58 . Cooling (of machines or engines in general F01P)
Heating
Diminishing heat transfer { for the motor of air-pump units F04D 25/082 ; cooling of shafts or bearings F04D 29/04 }

F04D 29/5806 .. { Cooling the drive system }

F04D 29/5813 .. { Cooling the control unit }

F04D 29/582 .. { specially adapted for elastic fluid pumps }

F04D 29/5826 ... { Cooling at least part of the working fluid in a heat exchanger }

F04D 29/5833 .... { flow schemes and regulation thereto }

F04D 29/584 ... { cooling or heating the machine (F04D 29/5846 , F04D 29/5853 take precedence) }

F04D 29/5846 ... { cooling by injection }

F04D 29/5853 ... { heat insulation or conduction }

F04D 29/586 .. { specially adapted for liquid pumps }

F04D 29/5866 ... { Cooling at last part of the working fluid in a heat exchanger }

F04D 29/5873 .... { flow schemes and regulation thereto }

F04D 29/588 ... { cooling or heating the machine (F04D 29/5886 , F04D 29/5893 take precedence) }

F04D 29/5886 ... { cooling by injection }

F04D 29/5893 ... { heat insulation or conduction }

F04D 29/60 . Mounting
Assembling
Disassembling { F04D 13/10 takes precedence }

F04D 29/601 .. { specially adapted for elastic fluid pumps }

F04D 29/602 ... { Mounting in cavities }

F04D 29/603 .... { means for positioning from outside }

F04D 29/604 .... { means for removing without depressurising the cavity }

F04D 29/605 .. { specially adapted for liquid pumps }

F04D 29/606 ... { Mounting in cavities }

F04D 29/607 .... { means for positioning from outside }
F04D 29/608 .... { means for removing without depressurizing the cavity }
F04D 29/62 .. of radial or helico-centrifugal pumps
F04D 29/622 ... { Adjusting the clearances between rotary and stationary parts }
F04D 29/624 ... { especially adapted for elastic fluid pumps }
F04D 29/626 .... { Mounting or removal of fans }
F04D 29/628 ... { especially adapted for liquid pumps }
F04D 29/64 .. of axial pumps
F04D 29/642 ... { by adjusting the clearances between rotary and stationary parts }
F04D 29/644 ... { especially adapted for elastic fluid pumps }
F04D 29/646 .... { Mounting or removal of fans }
F04D 29/648 ... { especially adapted for liquid pumps }

F04D 29/66 . Combating cavitation, whirls, noise, vibration or the like (gas-flow silencers for machines or engines in general F01N)
Balancing (surge control F04D 27/02)
F04D 29/661 .. { especially adapted for elastic fluid pumps }
F04D 29/662 ... { Balancing of rotors (compensating unbalance G01M 1/36) }
F04D 29/663 ... { Sound attenuation }
F04D 29/664 .... { by means of sound absorbing material }
F04D 29/665 .... { by means of resonance chambers or interference }
F04D 29/666 ... { by means of rotor construction or layout, e.g. unequal distribution of blades or vanes }
F04D 29/667 ... { by influencing the flow pattern, e.g. suppression of turbulence }
F04D 29/668 ... { damping or preventing mechanical vibrations }
F04D 29/669 .. { especially adapted for liquid pumps (F04D 29/18 takes precedence) }
F04D 29/68 .. by influencing boundary layers { (by bleeding elastic fluid F04D 27/0215) }
F04D 29/681 ... { especially adapted for elastic fluid pumps }
F04D 29/682 .... { by fluid extraction }
F04D 29/684 .... { by fluid injection }
F04D 29/685 .... { Inducing localised fluid recirculation in the stator-rotor interface }
F04D 29/687 .... { Plasma actuators therefore }
F04D 29/688 ... { especially adapted for liquid pumps }

F04D 29/70 . Suction grids
Strainers
Dust separation
Cleaning
F04D 29/701 .. { especially adapted for elastic fluid pumps }
F04D 29/703 ... { specially for fans, e.g. fan guards }
F04D 29/705 ... { Adding liquids }
F04D 29/706 ... { Humidity separation }
F04D 29/708 .. { specially for liquid pumps }

Guide heading: **Other non-positive-displacement pumps**

F04D 31/00 **Pumping liquids and elastic fluids at the same time**

F04D 33/00 **Non-positive-displacement pumps with other than pure rotation, e.g. of oscillating type** (F04D 35/00 takes precedence; hand-held fans A45B)

F04D 35/00 **Pumps producing waves in liquids, i.e. wave.producers** (for bath tubs A47K 3/10)